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ABSTRACT

This conference presentation outlines some of the important factors for teachers to consider when selecting software and hardware to be used as teaching tools in the vocational education classroom and as a means for teaching about the occupational applications of microcomputers. Addressed in a discussion of methods and criteria for evaluating hardware are central processing units, external memory, interfacing capability, monitors, and printers. The second half of the guide contains general guidelines for evaluating software; an examination of software costs; and a discussion of criteria for assessing the characteristics, documentation, user friendliness, and replicability of business and instructional software. (MN)

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VIRGINIA TECH

Evaluation of Technology for the Vocational Classroom

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AGRICULTURAL EDUCATION

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Evaluation of Technology for the Vocational Classroom

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"Evaluating technology for the vocational classroom"--a mighty undertaking indeed! Let us first limit the dimensions of the topic. What is "technology for the vocational classroom"? Working on the assumption that we are talking about this nebulous thing loosely referred to in the literature as "high technology", we must include robotics, fiber optics, microwave communications, laser technology, genetic engineering, videodisk technology, and supercomputers to name just a few. Within the next 2 to 5 years, interactive videodisk microcomputer technology will take the classroom by storm in a way that the microcomputer can never do. However, the current rage in education is the microcomputer. Therefore, the remainder of this presentation will deal only with the evaluation of microcomputer hardware and software.

Moreover, there are two major uses which vocational educators have for microcomputers: (1) as a teaching tool (computer assisted instruction, computer managed instruction, and as a tool for the teacher of administrator in managing school activities), and (2) to teach occupational applications. Of these two uses, the teaching tool uses are myriad and quite valuable for all teachers. But the unique mission of vocational education to train students for jobs in business and industry, makes the use of the microcomputer to teach occupational applications particularly important for our profession. Accordingly, the remainder of this presentation will consider not only the regular school applications aspect of the microcomputer, but just as importantly, the business applications of the microcomputer.

EVALUATING HARDWARE

There are over 200 models of microcomputers available to the prospective buyer today. With the demise of Osborne and the departure of Texas Instruments from this array, Compaq and others have taken their place. The industry shows little sign of settling down just yet. There are clear signs, however that the bewildering diversity of non-compatible machines is a thing of the past. With the emergence of IBM as the major determing factor in the industry's direction, microcomputer developments at least have a direction now. The question is rapidly becoming not what type of microcomputer to buy, but whether to go toward the Apple and Apple-compatible end of the spectrum, or toward the IBM and IBM-compatible end.

The central processing unit (computer) itself is only the first part of the microcomputer question. The next part is the selection of peripherals: printers, displays, modems, disk drives, remote monitoring devices, remote control devices, external or internal clocks, buffers, and many more.

Clearly, an exhaustive discussion of all of the intricies of microcomputer hardware and evaluation is well beyond the limits of a single book, much less a single paper. I will attempt to touch lightly on a few of the more important considerations for teachers in selecting several of the hardware components.

Central Processing Units

The computer must be selected in light of its intended use. Instructional uses place heavy demands on the structural durability of all parts of the computer, particularly its keyboard. For classroom use, the lightweight "home computers" are probably not wise selections. Business computers are usually more suitable because they are designed to stand the abuse. Beyond that, vocational educators are training students for jobs in business and industry. They will find IBM's in the largest numbers, followed by Apple's, followed by TRS 80's in the business world. Therefore, vocational students should probably train on these types of machines.

In terms of memory, a 4 kilobyte machine may be fine for playing a few simple games; however, for business training, nothing less than 64 K machines should be considered and 128 K would be better. Spreadsheet, data mangement, and word processing capabilities of small machines are seriously limited. In addition, the capability of the computer to offer 80 column display is essential.

External Memory

Cassette memory units are probably adequate for very limited operations and again for playing games. However, business applications almost universally require disk units. Vocational educators should not consider anything less than double disk drive units unless there is no other option. I would even recommend that one dual-disk drive unit be purchased rather than two cassette-drive units if that were the option. Many of the more sophisticated business applications software packages require at least two disk drives. Some packages require up to six disk drives for operation.

For the school system with adequate resources, the purchase of a hard disk drive for the administrator's and the teacher's use should be considered. Single floppy disk drive units are adequate for most student training; however, dual drive units are needed for many types of data management and accounting packages.

Interfacing Capability

The ability to communicate between the teacher's master computer and the student's computer will become increasingly important for such programs as business and office education. The development of software to drive such systems is moving forward rapidly. Classroom networking systems are available from several vendors now and will be less expensive and more readily available in the future.

Of perhaps greater importance is the telecommunications capability. The use of modems to access other computers via the telephone system is becoming increasingly important. At least one computer in the school should have this essential capability.

Monitors

The monitors is an important consideration. The screen should provide resolution adequate for 80 column word processing. Monochrome standard televisions are totally inappropriate for this. In fact, regular color

monitors are not adequate for this requirement. If you require a color monitor, it should probably be a high resolution screen, typically RGB monitors are adequate here.

The use of a color monitor is essential for most instructional software. Thus you are faced with a problem. RGB monitors are expensive. Monochrome monitors are not good for much instructional software and are not as interesting to work on for the student as color monitors are. And regular color monitors cannot be used for 80 column work.

Printers

A vocational classroom literally must have a printer available for teaching occupational applications of the microcomputer. In virtually all cases, a good dot-matrix printer is adequate. The current crop of printers includes a number of so-called "correspondence" quality machines. The quality of the print is largely determined by the number of dots used to form each letter. A 7x7 printer produces very rough looking but readable copy. A 7x9 is adequate for most uses. A 9x9 dot matrix is probably the best selection for business applications training. It produces a very good quality copy and is quite readable.

The reliability of the printer is of utmost concern. You should demand information from the vendor on mean time between breakdowns for printers being considered. If the vendor cannot supply that information, find another vendor or another printer. Another consideration is the width of the printer. Data management and spreadsheet programs require wider paper than 80 column. For straightforward word processing, an 80 column printer is adequate.

Still another consideration is printer speed. A 160 cps (characters per second) printer is twice as fast as an 80 cps printer. The waiting time while the printer is operating can be quite long for a slow printer and a long document. The use of a buffer can alleviate that problem by releasing the computer for continued operator use.

EVALUATING SOFTWARE

For many new microcomputer owners, an initial temptation is to try to become programmers. That is probably a useful idea to a limited extent, but only because it can help the user understand what the computer can and cannot do. It also gives the user a better appreciation for the intricate programming involved in some commercial software packages. Often such novices take it as a challenge to be able to write a program "to do something." Fortunately for most people, that temptation quickly leads to the realization that it is a great deal of work and requires a great amout of time to write even such a simple program as one to balance a checkbook. Moreover, there is probably already a program available to do almost anything you will want to do.

At the time of this writing, there are over 21,000 commercial software packages that can be readily identified on the software market. For some functions in business, such as general accounting, there are well over 50 software packages available for a single brand of microcomputer. There are

at least 150 new packages being developed each month during early 1983, and that figure will probably rise to 250 per month by late 1984. Clearly the range in the quality of those packages is from excellent to very poor, but how is the buyer to know? One purpose of this paper is to suggest characteristics to look for in software for use in the vocational classroom and laboratory.

Software Costs

What are you "buying" when you pay $599.00 for a general ledger program? The typical software buyer assumes that such a purchase carries with it all the normal rights associated with ownership, but that is not usually the case. Most vendors do not actually "sell" their software at all. What they do is license the right to use their software diskette to the purchaser while retaining actual ownership of the diskette and the program contained on it. The purchase price of such software is not a purchase in the traditional sense of the word. Rather it is more like a one-time rental fee. Such an arrangement is called a program license fee. For the remainder of this presentation, the terms purchasing and licensing will be used interchangably.

Since the software remains the property of the vendor, its contents are not legally the property of the rentor and as such cannot be legally copied, modified, or in any other way tampered with by the rentor. Even when the vendor actually sells the software to a purchaser and conveys ownership, the program itself is almost invariably copyrighted. In fact, the vendor's prohibitions often prevent the licensee from even making backups for his or her own use. This may even extend to prohibition of the use of the same package in more than one location or on more than one machine in the same office.

Most software vendors at least prohibit the reproduction of copies of these programs. In a further effort to prevent unauthorized software copying, often called pirating, most vendors "copy protect" their products with an assortment of programming and production techniques. It is possible to copy virtually any diskette using either specially written copy programs or hardware which has been specifically developed for that purpose. However, such activities are illegal and as such are certainly not good practice for a small business operator. Thus, when you purchase most software packages, you are purchasing or renting a single, or perhaps an original and a "backup", diskette containing a program or series of programs designed to perform some function.

Many types of programs perform functions which change frequently. For instance, tax packages are based on regulations which change with every new Internal Revenue Service whim. Such programs can quickly become out of date, or even completely wrong. For that reason, reputable vendors of such software packages frequently provide a "maintenance" or "update" service. Typical provisions allow the licensee to purchase such updates for less than the normal fee. In some cases, the vendor may provide such a service on a cost recovery basis or even free. This can be an important consideration in software purchases.

Source code is the hard copy (i.e. printed) listing of a program. When a vendor copy protects its programs, you will not be able to produce a printed copy. Without a listing, it is impossible for the user to make any

customizing modifications to the program. If the vendor allows the purchaser to make such modifications, a copy of the source code is required. This charge is not typically included in the original license fee and can be substantial. As another alternative, some vendors prohibit the licensee from making such alterations but provide such services themselves. Customizing fees can be based on a set amount or on an hourly rate for programming time.

As a rule, the licensee receives a complete set of documentation with the original fee. This is not always the case, and additional documentation may be available for the novice at an additional charge. Further, as revisions are made to the basic documentation, the vendor may or may not provide it to existing licensees at reduced costs or free. This is an additional source of software costs which do not appear on the package.

Another hidden source of potential cost lies in the financial position of the vendor itself. Since most software is licensed rather than actually purchased, it remains the property of the vendor. Moreover, anybody can be a software vendor. It is such a new industry that virtually anybody with a microcomputer and ability in programming can produce and sell software. That means there are many software vendors with less than stable business foundations. When one of those vendors declares bankruptcy, the software may be considered one of the vendor's assets by the court. This eventuality could result in your having to repurchase rights to the software again, the second time from the vendor's creditors. Unfortunately, this situation is not an unheard of occurrence. Thus it is important that you consider the stability and reputation of the vendor as you make software decisions.

User support from the vendor can be extremely important. The vendor who licenses its software to you and then provides no mechanism to answer your questions or to provide advice and assistance should be viewed with suspicion in expensive software purchases. No matter how good the documentation, there will always be unforseen problems and questions from vendors. A "hotline" using an 800 number for toll free user questions is a common service of the larger software companies.

Business Software

Characteristics

Software developed for business purposes is typically free of many of the motivational and attention-getting gimmicks which characterize instructional software. Business software seldom uses graphics except for presentation of data and is usually presented on monochrome screens. It relies on the inherent incentive of the profit motive to drive its users and rarely, if ever, uses such personal touches as addressing the user by name. Business software, in other words, is practical and straightforward.

At the same time, it must be simple to use and contain enough internal prompts to keep the user on track. Most users find that menu-driven software is simpler to use than other formats. Menu driven means that the program returns throughout its operation to a list of the user's options and asks the user to specify which step is desired next. PFS: File, for instance is menu driven. Whenever the user completes any operation, the program returns to the menu and presents the following options:

1. Create File
2. Add Form
3. Copy File
4. Search/Update
5. Print
6. Remove.

These are all of the things that the program can do and the user must select one of them before proceeding. When one is selected, the program displays another sub-menu which specifies all the ways that it can perform that task. This format leads the user from one step to the next while decreasing the probability of human error.

On the other hand, Apple Writer II, which was used to develop this paper, is not menu driven. That means the user must remember or look up the command for each operation, such as saving files or for reading the catalog of files on the disk. That presents no problem as long as a package is used frequently, because the operator quickly learns the commands and uses them regularly. One disadvantage of menu-driven software is that additional programming is required to display and operate the menu itself. This may occupy memory space in the computer which could be used for working space. Thus, non-menu-driven software can be more efficient users of memory but menu-driven software can be easier to use.

One additional characteristic particularly important to business software is reliable operation. It is potentially devastating to make business decisions based on systematically wrong analysis. Yet that is just what can happen if incorrect formulas or procedures are programmed into a business software package. An astute businessperson will simply not rely on new software for sensitive analysis until it has proven itself accurate by trial runs of sample data with known results. Reviews by reliable software critics may satisfy this requirement. Additionally, trial runs of a software package can uncover instances where the package simply does not do what it is supposed to do for a given situation and set of instructions. Again, reliable reviewers can help in this regard. Reputable software developers and vendors are probably your best safeguard against these sorts of problems. Beyond that, a reputable vendor that discovers errors in its programs can be expected to correct those errors at no or little cost to the licenseee. License agreements should indicate vendor policy on this matter.

Documentation

The first tangible evidence of quality you will see is the program documentation, or written instructions. And while no amount of documentation can make a poor program into a good one, inadequate documentation can make even the best business software unusable. In the early years of the computer age, documentation for computer software was written largely by programmers for users with familiarity with computer operation, not for the general public. That was adequate until the microcomputer revolution made the general public into microcomputer users. Most small businesspersons do not have the time, inclination, or need to become experts on computers. For that reason, you should carefully examine the documentation of any business software before purchasing it. Documentation should be clear,

concise, and written in plain language. Secretaries, bookkeepers, and for that matter managers should not have to interpret passages like "each plot routine resides at $8F00-8FFF, and each must use the shape index table at $9380-93FF...", an actual instruction from a graphics software package.

The documentation should also contain tutorial materials that lead the novice through solution of a sample problem or exercise. Examples are often more valuable to the beginning program user than even the clearest of instructions. If examples are given, they should include correct results and they should work. It is amazing how often sample problems listed in software documentation simply do not work when the user tries to work through them. Disk Operating Systems (DOS) change. Microcomputer models change. Instructions valid for one printer and interface combinations are not correct for other combinations. The documentation should take these variations into account.

User friendliness

A software package is said to be user friendly when it is easy to use. A user friendly program prompts the user whenever he or she makes a mistake. It is forgiving of ignorence and mistakes. It does not suddenly abort a run, rudely inform the user that an error has been made, and discard all the data which has been in memory. Programs do all of these things unless the programmer foresees all the possible errors and accounts for them in the development stage. To test for user friendliness, try to make a mistake. Do something that is obviously inappropriate. The more user friendly the program, the more likely the computer will correct you.

Another aspect of user friendliness is in the degree to which the program is self explanatory. VisiCalc is very forgiving of mistakes in that it simply refuses to accept any responses that it does not expect. If you are attempting to replicate a row and do not enter one of a very limited selection of acceptable responses, it simply returns you to the spreadsheet and makes a crude beeping sound. It does not however, tell you that you made a mixtake or even hint as to the nature of the mistake. In this latter sense, then it is not very user friendly. The documentation must make up for this shortcoming or the user can experience great frustration.

Copyability

As I pointed out earlier, many software vendors prohibit or even physically prevent the user from making duplicate copies of programs. This means that if you will need an expensive software package to be used in more than one place at a time, you may have to purchase multiple copies. For instance, the vocational teacher who plans to use a general accounting package for a full class of students may find it necessary either to make copies of the program or spend an additional $100 to $600 for every additional two copies (a backup copy is normally provided with each purchase.)

On the other hand, some venders allow the user, especially in schools, to make additional copies for his or her own use. This corporate generosity is not required and certainly should not be abused. In fact, for persons

contemplating purchasing expensive business software, this policy can be very important. Copyability might be a determining factor in the decision-making process when otherwise equal packages are available to perform the same functions.

Instructional Software

Characteristics

Whereas business software can rely on internally motivated users, the same is certainly not true of instructional software. This latter category of programs must use an array of attention-ge-ters and motivational devices to maintain user interest. Graphics are essential in quality instructional software. In fact, color graphics are probably even better. On the IBM, graphics are simply not possible without the color adapter board, so this can be a problem on microcomputers purchased strictly for business purposes.

Beeps, whirring sounds, flashing displays, and moving drawings certainly add to the attractiveness of instructional software. One additional nicety in this area is the personalization possible with interactive programming. The well designed instructional program doesn't say, "Invalid response" it says, "I'm sorry Bob, but that isn't right. Perhaps you should review that part again."

One particularly important characteristic of instructional software lies in the area of error proofing. Because computer instruction is frequently individualized, it is essential that the teacher be able to leave the student with the computer with little fear that a mistake, either accidental or intentional, will cause the program to abort.

Instructional software can take one or any combination of the following forms:

1. drill and practice
2. tutorial
3. simulation.

Drill and practice packages allow the student to repeat a carefully regulated task over and over until the skill is mastered or until proficiency is attained. Examples are the numerous typewriting programs, math drills, and language drills available. Tutorials are generally used to teach conceptual material. Essentially, tutorials are similar to electronic "books" with interactive capability. Simulations use models to represent other situations. An example of a simulation is the Sandwich Shop reviewed in Chapter IV, which sets up a model of a business to teach economic and management concepts, skills, and attitudes. The student makes inputs and receives feedback based on the results of that input.

Documentation

The documentation for instructional software is usually not as detailed as that for business software. Except for some complex simulations, it need not supply such intricate details for the user, because instructional software must be much more user friendly than business software. Business software

performs a function and the user learns to use it proficiently. The basic purpose of instructional software is to teach something and any time spent learning to use the package is time lost from the central task of learning that task, concept, or skill.

For this reason, documentation is probably as simple and brief as possible. It must contain all the information required by the student to run the package, and a description of what the package does (hopefully including behavioral objectives), but no more. In the case of simulations, particularly very complex ones, sample problems with correct solutions may be supplied. Everything else should be contained in the program itself. It is not unusual for documentation for tutorials to contain only the information needed for a total novice to turn on the computer and begin running the program. This is clearly inadequate documentation since it fails to indicate the purpose of the program or its intended audience.

User Friendliness

User friendliness is even more important in instructional software than it is in business software. This is because, as discussed earlier, the user of instructional software is probably a one-time user of a particular package whereas the user of a business package trains to build proficiency in using a particular package. Just as the documentation for a business package must be very thorough, instructional packages must be very user friendly.

When input is required from the student, it should be requested clearly in plain language. The student should not have to look up the format or command for the next input. Exceptions to this generalization are possible, of course, as in the case of some complex simulations; but in general this is a valid requirement.

Variety in presentation is important, too. Any good teacher knows that students learn better when the material is presented in a variety of ways. A 60 minute lecture or reading session can be deadly to the interest level of any class. By the same token, instructional packages should display a variety of formats. The student should be required to alternately read material, study illustrations, respond to questions, and receive feedback throughout the program.

Personalization is an important aspect of interactive Computer Assisted Instruction (CAI). Use of the student's name can be a good motivator. In addition, requiring the student to enter his or her name allows the program to record the results of each student's efforts.

Most good interactive CAI packages provide checks of the student's progress by asking questions or presenting problems to which the learner must respond. By keeping track of the percentage of correct and incorrect resjponses for each student, the program can provide the instructor with valuable progress reports and at the same time give the learner continual feedback.

Copyability

Copyability is probably even more important to the educator than it is to the businessperson. School budgets are always tight and once funds are allocated, there is usually no more forthcoming. Moreover, the number of

students who will be using a package at one time can be very large. For instance, a word processing class may need 30 to 50 copies of a program such as WordStar at the same time. At $495.00, 30 copies would be quite expensive. Taking the peculiarities of educational institutions into account, some software vendors allow schools to make additional copies of programs. This consideration must surely be taken into account when making purchasing decisions for instructional software. This corporate policy is generous and instructors should be meticulously careful not to violate the conditions of such copying or risk losing the privilege.

Along the same line, many software packages are written in such a way that, once loaded into the machine, the diskette can be removed and the program loaded into more machines. Teachers should be aware that this is a violation of standard software leasing agreements which limit the use of any given diskette to a single machine. Again, some vendors allow the use of their packages in multiple machines for schools only. This corporate policy too is vary generous, and the limitations imposed by the vendor should be strictly observed. Teacher who demand honesty and individual work from their students can hardly expect such high levels of conduct while simultaneously copying copyrighted privileges. Certainly this consideration on the part of the vendor should be taken into account when making software purchasing decisions for schools.

Evaluation Forms

Business Software

To facilitate the evaluation of business software packages, it is appropriate to use some sort of standardizing checklist. This insures that all the packages being evaluated are compared on the same criteria. It also insures that the reviewer does not forget any of the criteria for a given package. The folllwing evaluation instrument may be helpful in the evaluation of business software.

Instructional Software

Instructional software is similar in many ways to business software. Thus many of the same criteria can be used in evaluating both types of software. At the same time, the two differ in a number of essential characteristics. For that reason, the evaluation checklist for instructional software which follows is similar to yet differs somewhat from the checklist for business software.

Microcomputer Business Software

Evaluation

Package Title_____

Version_____ Price_____

Functional Area_____

Specific Tasks Performed_____

_____

_____

Vendor & Address_____ Phone_____

_____

_____

Hardware Requirements_____

_____

Medium 5-1/4" disk____ 8" disk____ Cassette____ Other_____
(specify)

Other Software Required_____

_____

Package: Single Program_____

Compatible With_____

Part of Integrated Series_____

Copy Policy/Copyability_____

_____

Rating Scale: 1=very poor
to
10=excellent

DOCUMENTATION:

1. Clear & unambiguous _____
2. Consistent with hardware _____
3. Defines technical terms _____
4. Contains tutorial section _____
5. Provides examples that work _____
6. Completely explains all functions _____
7. Instructions produce expected results _____

User Friendliness:

1. Commands simple & easy to remember _____
2. Adequately prompts user for input _____
3. Corrections are easy to make _____
4. Menus are unambiguous _____
5. User can escape program at any point _____
6. Help menu is adequate _____
7. Program catches user errors _____

Content:

1. Program performs accurately (i.e. gives correct answers) _____
2. Output is simple to interpret _____
3. Program performs reliably (i.e. same results consistently) _____
4. Uses procedures consistent with actual business operation _____

TOTAL SCORE: _____

Critical Problem Areas _____

Unusual Strengths _____

Overall reaction: I recommend purchase of this package _____

I do not recommend purchasing package _____

Reviewer Name _____ Date _____

Microcomputer Instructional Software

Evaluation

Package Title_____ _____

Version_____ Price_____

Subject_____ Grade Level_____

Specific Skills/Concepts Taught_____

_____

Vendor & Address_____ Phone_____

_____

_____

Hardware Requirements_____

_____

Medium 5-1/4" disk____ 8" disk____ Cassette____ Other_____
(specify)

Other Software Required_____

_____

Package: Single Program_____

Compatible With_____

Part of Integrated Series_____

Copy Policy/Copyability_____

Instructional Purpose (check all that apply):

Redmediation _____
Regular Instruction _____
Enrichment _____

Instructional Technique (check all that apply):

Drill and Practice _____
Tutorial _____
Simulation _____

_____

Rating Scale: 1=very poor
to
10=excellent
NA=Not Applicable

Documentation:

1. Clear & unambiguous _____
2. Consistent with hardware _____
3. Defines technical terms _____
4. Contains sample problems with solutions _____

User Friendliness:

1. Comamnds simple & easy to remember _____
2. Adequately prompts user for input _____
3. Corrections are easy to make _____
4. Menus are unambiguous _____
5. User can escape program at any point _____
6. Provision made for review or back up _____
7. Help menu is adequate _____
8. Program catches user erros _____

Content:

1. Content is accurate _____
2. Content is complete _____
3. Performance objectives are given _____
4. Content has educational value _____
5. Material is logically arranged _____
6. Quiz administered, scored, and recorded _____
7. Reading level is appropriate _____

Presentation:

1. Illustrations appropriate/attractive _____
2. Sound effects are appropriately used _____
3. The screen is used effectively _____
4. Old material is removed prior to new being displayed _____
5. No unnecessary delays are built in _____
6. Periodic progress checks are included _____
7. Student is recycled through material when progress is not satisfactory _____

TOTAL SCORE: _____

Critical Problem AReas _____

_____

Unusual Strengths _____

_____

Overall reaction: I recommend purchase of this package _____
I do not recommend purchasing package _____

Reviewer Name _____ Date _____